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SOURCE Radioaktivnyye Izotopy v Meditsine i Biologii

REVIEW AND TABLE OF CONTENTS OF SOVIET BOOK ON APPLICATION
OF RADIOACTIVE ISOTOPES IN MEDICINE AND BIOLOGY

Review

As indicated on the title page and in the introduction, Radioaktivnyye Izotopy v Meditsine i Biologii (Radioactive Isotopes in Medicine and Biology) by I. I. Ivanov, V. K. Modestov, Yu. M. Shtukkenberg, Ye. F. Romantsev, and Ye. I. Vorob'yev, Medgiz, Moscow, 1955, 232 pages, is a practical manual for scientific workers and clinicians who use radioactive isotopes or come into contact with them. This book does not attempt to give a review of research done in individual countries, nor, in the majority of cases, does it differentiate between USSR results and results of work done in other countries. It lacks a systematic bibliography. The date at which compilation of material for the book was completed is indicated by the fact that the element with the atomic number 100 (centarium) is referred to as having the heaviest known atom.

Part 1 (pp 5-103) reviews the physics of the structure of atoms, of penetrating radioactivity, radiation, and radiometry with particular attention to practical calculations and corrections to be made in the values obtained. Typical examples of calculations are given. In the section on recording instruments (pp 65-103) detailed information on the design, characteristics, and operation of the following devices is given: alpha-particle counter, beta-particle counters B-1, B-2, TM-20, and TM-40, and gamma-radiation counters AMA and AMM. The measuring devices of the "B" series are cylindrical counters or counter tubes for beta particles of medium energy, while the measuring devices of the TM series, referred to as "face" or "end-view" counters, are to be used for low-energy beta particles and are identical in design with alpha-particle counters. The TM counters have a mica window at the end. The AMA device is an argon-methylal-akvodag counter, the cathode of which is covered with "akvodag," i.e., a conducting graphite coating, while the words argon and methylal refer to the composition of the gas with which the counter is filled. The AMM (argon-methylal-copper) counter is

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similar to the AMA device in design, except that the cathode is coated with copper. A T-20 counter (p 94) and AML tube counter (p 113) are also mentioned.

Starting with page 85, the text describes special uses of counters (measurement of the radioactivity of liquids with the aid of "B" counters), the operation of scintillation counters, and counter circuits, together with the auxiliary equipment used in these circuits.

Chapter I of Part 2 deals with the arrangement of laboratories in which work with radioactive tracers is carried out and methods of work with these tracers (pp 104-110), rules to be observed in work with counter assemblies, particularly counter assemblies of the "B" type (pp 110-114), methods for the measurement of the activity of objects tested in biological experiments (pp 115-118), the calculation of the concentration of radioactive tracers and methods of administering them in a dissolved state to experimental animals (pp 118-121), the preparation of tissue samples for the measurement of radioactivity and mounting of these samples on supports or "targets" (pp 121-123), some rules for carrying out experiments with tagged compounds in vitro (pp 123-125), possible errors in experiments (pp 125-129), the interpretation of experimental results, particularly from the standpoint of determining the rate of regeneration of body proteins (pp 129-130), paper chromatography of compounds containing radioactive tracer atoms (pp 130-135), the principle of the method of determining the concentration of a substance in solution by means of radioactive isotopes (pp 135-136), autoradiography (pp 136-143), and the principle of working with compounds which contain several different radioactive isotopes as tracer atoms (pp 143-145).

As distinguished from Part 1, which mentions specifically only well-known work done by famous scientists such as Rutherford, Sklodovska-Curie, Einstein, Mendeleyev, etc., Part 2 refers on several occasions to less known and more recent work carried out by USSR and other investigators, with emphasis on results obtained by USSR investigators. Thus, in the section on experiments with radioactive isotopes in vitro (pp 124-125), a comment by V. N. Orekhovich is included; the section on possible errors in carrying out experiments (p 125) contains a statement by A. Ye. Braunshteyn; in the directions for chromatographic work (pp 130-135), procedures devised by T. S. Pashkina and Z. I. Zhulanova are described; and in the section on autoradiography (pp 136-143), which has been written by Ye. V. Erleksova, references are made to work done by herself, B. N. Tarusov, L. V. Mysovskiy, and A. P. Zhdanov.

In Part 3, references to USSR work are also relatively frequent. On page 172 (tables 15 and 16) the maximum permissible doses of Na^{24} in clinical work are given on the basis of calculations made by N. G. Gusev, who also calculated the activities of 52 radioactive isotopes listed in Appendix 1. In the section on the application of radioactive iodine in investigations of the functional condition of the thyroid gland (pp 172-177), work by N. A. Gabelova is mentioned. This section also refers to the use of counter tubes AMM-4, AMM-2, and V-2, the latter possibly being a misprint for B-2. In Chapter III of Part 3, detailed specifications for disodium orthophosphate containing radioactive phosphorus and supplied for therapeutic use are given. To aid in the calculation of doses of radioactive phosphorus to be administered to patients, a table drawn up by V. A. Petrov is reproduced (Table 23, p 163). Directions for therapeutic procedures involving use of radioactive phosphorus in the treatment of leukoses (pp 167-180) are apparently based on USSR experience, because administration of hematogen (a USSR drug) is recommended. It is stated in the directions for the treatment of erythremia that the radioactive phosphorus preparation supplied by the USSR industry for therapeutic use at present (i.e., disodium orthophosphate) should be

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administered internally by the peroral method only and not given subcutaneously (p 165). Directions for the calculation of doses of radioactive phosphorus according to a procedure by V. A. Petrov and Ye. A. Liberman are given in a section on the therapy of capillary angiomas by the external application of disodium orthophosphate (pp 190-194).

Part 4 is interspersed with references to USSR work to a still greater extent than Part 3. It does not contain any references to work done outside the USSR. In Chapter I of Part 4 acute radiation sickness is described on the basis of information given in the book Ostryy Luchevoy Sindrom (The Syndrome of Acute Radiation Sickness) by P. Gempel'man, G. Lisko, and D. Gofman, published in 1954. A typical case history of acute radiation sickness resulting from contact with a nuclear reactor is described, but no therapeutic measures are mentioned. The section on subacute radiation sickness and skin injuries in chapters II and III also lacks information on therapeutic measures. In Chapter IV, which deals with measures to be taken for the protection of personnel working with radioactive isotopes, cleanliness and regular medical inspection are emphasized. In connection with medical examinations, the official directions entitled Instruktsiya po Provedeniyu Periodicheskikh Meditsinskikh Osmotrov Lits, Rabotayushchikh s Radioaktivnymi Izotopami (Instruction on Carrying Out Medical Examination of Persons Who Work With Radioactive Isotopes) is mentioned. It is pointed out that penetrating radiation first of all affects hemopoiesis, so that regular blood examinations are necessary. The changes in the blood and blood formation processes which take place under the effect of ionizing radiation are outlined on the basis of the text of the book Krovotvoreniye i Ioniziruyushchaya Radiatsiya (Hemopoiesis and Ionizing Radiation) by A. P. Yegorov and V. V. Bochkarev, Medgiz, 1954 (footnote to Chapter II).

Before discussing protection against external radiation (pp 205-210), protection against external contamination with radioactive substances (pp 210-211), and protection against inhalation of radioactive dusts (p 211), the authors point out in Chapter IV that resorption of radioactive substances as a result of swallowing or inhaling them is more dangerous than exposure to external radiation. They discuss the manner in which the isotopes Co^{60} , P^{32} , and J^{131} are deposited in the body after resorption. The variables which determine the nature of the action of radioactive substances on the body are listed on the basis of a statement attributed to S. M. Gorodinskiy and G. M. Parkhomenko.

In the section of Chapter IV dealing with protection against external radiation, directions are given for the calculation of the thickness of protective shields and of the walls of containers. A table showing the thickness of the layers of air, water, and aluminum which protect against beta particles of different energies is embodied in the text (Table 31, p 206). This table has been taken from N. G. Gusev, Sanitarnyye Pravila i Normy pri Rabote s Radioaktivnymi Izotopami (Sanitary Rules and Standards in Work With Radioactive Isotopes). According to a footnote, the values contained in the table have been calculated by Gusev. The text further contains a nomogram for the calculation of safe distances from a source of gamma radiation and a nomogram for the calculation of the thickness of lead shields that give protection against gamma radiation. These nomograms (Figures 62-83, pp 206-209) are also taken from Gusev's book.

The section of Chapter IV which deals with protection against external contamination with radioactive substances contains the recommendation that the soap OP-10, a product manufactured by enterprises of the Ministry of Chemical Industry, be used when it is necessary to remove radioactive sulfur or radioactive phosphorus from one's hands. The section on the protection

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against radioactive dust recommends that respirators with easily replaceable filters F-45 and F-46 be used when the danger of exposure to radioactive dust exists.

The section (pp 215-216) of Chapter V (pp 212-216) in which information is given on the maximum permissible amounts of radiation to which persons working with radioactive substances may be exposed states that the permissible amount of external gamma-radiation is 0.05 r per working day, that the maximum amount of external beta radiation is 0.05 of a roentgen physical equivalent (rpe or "fer" in Russian) per day, and that in exceptional cases the daily amount of radiation may be increased, but should not exceed 0.05 r or 0.05 rpe. The text of this section goes on to say that the maximum amount of radiation to which the hands are exposed may be greater by a factor of 5. Formulas for the calculation of the maximum permissible time of exposure depending on the intensity of the gamma or beta radiation and, conversely, for the calculation of the maximum intensity of radiation to which one may be exposed for a certain length of time are then given (Table 32, p 215). The maximum permissible amount of radiation due to contamination of floors, walls, and other surfaces in laboratories is given as 10,000 beta particles per minute emitted from a surface of 150 square centimeters and that due to the contamination of hands as 1,000 beta particles per minute emitted from the surface of the palm. The highest permissible concentration of radioactive isotopes in drinking water is stated to be 10^{-9} curies per liter and in the air of laboratories (in the form of dust or gas) 10^{-11} curies per liter.

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